Partnerships in studying the efficiency of a stormwater wetland

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Introduction

Wetland Restoration

- Functional stormwater wetlands can serve as a natural solution to aging water infrastructure and climate change adaptation in urban areas.
- Natural wetlands are known to slow down water movement, trap sediment and nutrients, and allow for microbial and plant processes to reduce nutrient loads headed downstream.

Collaboration & Partnerships

- The U.S. EPA and contractor reached out to its local university to begin the project.
- Environmental Science faculty worked with EPA staff, the contractor, and the original wetland restoration consultant to design the research efforts.
- University faculty and undergraduate students carried out the research. Multiple disciplines including biology, geology, and geography were involved.
- Students were engaged via research assistantships and senior class projects.

Study Objectives

1. Measure water retention of stormwater wetland.
2. Measure nutrient retention of stormwater wetland.
3. Determine nutrient flux of wetland nutrients.

Site and Methods

- Located at an elementary school in northern Kentucky, the wetland is 0.54 ac in size with a 16 ac watershed (Fig. 1).
- Inlets include 3 pipes and an incoming intermittent stream; 1 outlet pipe empties into a nearby stream (Figs 2 & 3).
- Samples were collected during storm events using ISCO auto samplers triggered by a rain gage and flow meter.
- Level loggers were installed in wells to measure water level fluctuation during storm events.
- Samples were analyzed for solids (TSS & TDS), phosphate, ammonium, and nitrate concentrations.

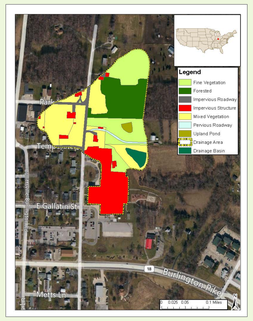

Fig. 1. Map of the wetland watershed details the land use of the area that drains into the wetland. GIS work done by NKU undergraduate, Brian Robertson.

Results

O1: Wetland retained stormwater longer than anticipated – extra efficient

Fig. 2. Wetland during winter; vantage from inlet.

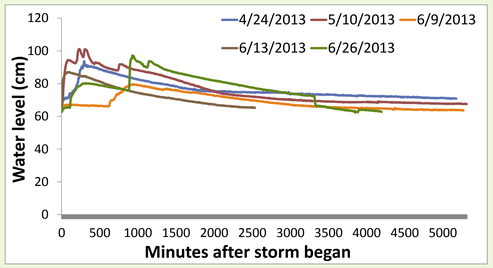

Fig. 4. Surface water level of wetland for each storm event.

Fig. 3. Wetland during summer; vantage from outlet.

O2: Wetland retained nutrients and reduced downstream movement

Nutrients were retained after all measured storm events

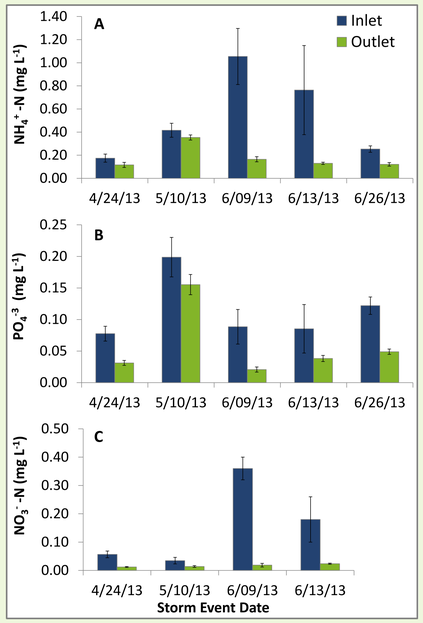

Fig. 5. Average nutrient concentration by location for each storm event. (A)=ammonium-N, (B)=phosphate, (C)=nitrate-N.

Immediate washing of nutrients off landscape at storm event onset

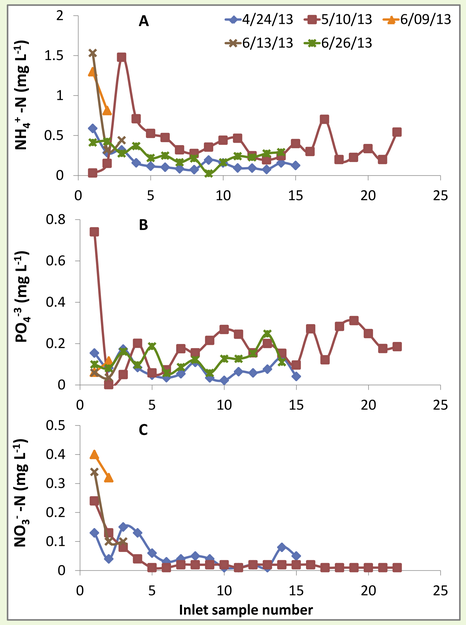

Fig. 6. Inlet nutrient concentrations in order as they wash off the landscape. (A)=ammonium-N, (B)=phosphate, (C)=nitrate-N.

O3: Determining nutrient flux of the wetland

- We are currently working on calculations to estimate total nutrient flux for each measured nutrient – this will tell us the nutrient flux in the wetland for each storm event.
- To do this we will first calculate the water volume of the wetland using the bathymetric contours (Fig. 7) and water level data for each sampling interval during a storm event.
- Then we will use the volume and the nutrient concentration during each sampling interval to calculate the total nutrient flux.

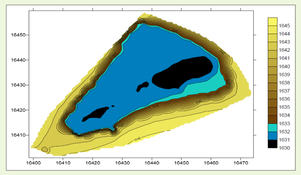

Fig. 7. Bathymetric survey completed by NKU Geology students.

Discussion

The restored stormwater wetland *is* functioning efficiently – retaining water and nutrients

- The wetland held stormwater long after storm onset (Fig. 4); reducing the volume of stormwater runoff entering the nearby stream during a storm event.
- Retention of stormwater allows time for nutrient reduction by microbes and plant uptake in the wetland. This was demonstrated by the reduced outlet concentrations (Fig. 5).
- While the input of nutrients from the watershed may spike during periods of intense rain (Fig. 6), the wetland is efficient at removing them before water continues on downstream.

Benefits of collaborative partnerships

- Multi-partner collaborations bring together strengths from multiple disciplines to conduct research in a low-cost, efficient, and mutually beneficial way.
- Universities are a prime location for multiple disciplines to collaborate on projects. In our project, we easily found geologists, geographers, and water quality specialists all in one locale.
- Restoration organizations can bring site specifics and engineering background.
- Government groups provide support, resources, and just as important – motivation and inspiration for the projects.
- The best part of these partnerships is the involvement of undergraduate students – providing opportunities to train the specialists of the future.

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